REMARKS

Claims 50-65 are pending in the subject application. Claims 50 and 59 have been amended to incorporate the limitations recited in claims 51 and 60 respectively. As a consequence, claims 51 and 60 have been cancelled. In the Office Action, claims 50-65 are rejected under 35 U.S.C. §102. More specifically, claims 50-58 were rejected under 35 U.S.C. §102(e) as being anticipated by U. S. Patent No. 5,718,948 issued to Ederyd et al. ("Ederyd"), and under 35 U.S.C. § 102(b) as being anticipated by U. S. Patent No. 5,370,944 issued to Omori et al. ("Omori"); claims 50-65 were rejected under 35 U.S.C. §102(e) as being anticipated by U. S. Patent No. 5,624,766 issued to Moriguchi et al. ("Moriguchi") and under 35 U.S.C. § 102(b) as being anticipated by U. S. Patent No. 5,494,635 issued to Bennett ("Bennett") or by U. S. Patent No. 5,484,468 issued to Ostlund et al. ("Ostlund") or by U. S. Patent No. 5,478,634 issued to Setoyama et al. ("Setoyama") or by U. S. Patent No. 5,451,469 issued to Gustafson et al. ("Gustafson") or by U. S. Patent Nos 5,374,471 or 5,372,873 issued to Yoshimura et al. ("Yoshimura") or by U. S. Patent No. 4,399,168 issued to Kullander et al. ("Kullander"). Applicants herein submit the following remarks and arguments to overcome the rejections.

Claim Rejections under 35 U.S.C. § 102

Claims 50-65 are rejected under 35 U.S.C. § 102 as being anticipated by ten issued patents. In the Office Action, the Examiner stated that cited prior art patents disclose the claimed coatings on an etched surface free of eta phase and made from the claimed components. Applicants respectfully tranverse the rejections and disagree that the disclosure of the cited patents anticipate the product claims of the subject application, and request reconsideration of claims 50-65 as herein presented.

The claims of the subject application are directed to an article, comprising a composite portion comprising hard constituent particles in a binder, an etched surface region substantially free of eta phase, the etched surface portion comprising substantially intact hard constituent particles and voids between the substantially intact hard constituent particles, wherein the voids extend to the composite portion, and a wear resistant coating on the etched surface region and disposed in the voids. The phrase indicates that the hard constituent particles of the etched surface portion are substantially similar to the hard constituent particles of the composite portion. However, the binder material is removed from between the substantially intact hard constituent particles of the etched surface portion to create voids, with the voids extending into the composite portion and to a depth of between 3 microns and about 15 microns. The wear resistant coating is disposed on the etched surface region and in the voids. The cited prior art references, as individually discussed below, do not include the structure of the article as described in the limitations of independent claims 50 or 59, as amended or claims 52-58 and 61-65 dependent therefrom.

In the Office Action, the pending claims in the subject application are rejected based on ten references, which in the Examiner's opinion anticipate the pending claims under either 35 U.S.C. § 102 (b) or (e). Yet, according to § 2131 of the MPEP, "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Applicants respectfully submit that claimed article is patently distinct from the cited prior art since the articles do not disclosed each and every element as set forth in the claim. The references may disclose a substrate and a coating, but the structures of the articles in the references are different than the claimed article. The articles

disclosed in the prior art comprise a different structure between the coating and the substrate than the article claimed in the subject application. Each structure takes a different approach to increasing the adherence of the coating to the substrate. Applicants herein discuss these structural differences. All citations refer to the prior art reference unless otherwise stated.

U. S. Patent No. 5,718,948 issued to Ederyd et al.

Ederyd discloses a method of coating a cemented carbide body. The specification discloses a cemented carbide body comprised of a core made up of an alpha, beta and eta phase, a surface made up of an alpha and beta phase but free of the eta phase and a diamond or cBN coating. *See column 2, lines 25-43.* The surface zone has a reduced binder content and width of at least 0.4 mm, preferably 0.8 mm. *See column 2, lines 51-61.* The binder phase in the surface zone can be removed by etching. *See column 2, lines 62-67.*

In contrast, in the claimed article, as amended, the etched surface region comprises voids extending to a depth of between 3 microns to 5 microns. Thus the surface zone with reduced binder content in the claimed article has a width of at most 0.005 mm, well below the width of the surface zone of the Ederyd patent. The Ederyd reference does not disclose the production of voids on the surface of the carbide body nor that the coating is disposed in voids on the surface of the carbide body. Therefore, by disclosing a product with a surface zone of reduced binder content that is significantly wider and does not does not contain voids in which the wear resistant coating is disposed, the disclosures of Ederyd do not include each element set forth in claims 50-58 of the subject invention.

U. S. Patent No. 5,370,944 issued to Omori et al.

Omori discloses a diamond-coated tungsten carbide-based cemented carbide containing a "surface modified layer" which is either binder phase free or where the binder phase proportion is less than in the interior. *See column 5, lines 55-59.* The substrate surface may then be etched, however the etching is only to remove binder that oozes onto the surface and not to etch to produce voids. *See column 8, lines 52-53 and lines 64-67.* Omori states that the strength of the substrate is lowered when the binder phase around the hard phase is removed by etching (*see column 5, lines 64 to column 6, line 2*), so presumably the limited etching does not produce voids. Omori does disclose the etching of the binder phase present in the surface-modified layer. *See column 15, lines 59-61.* Omori also discloses scratching the surface of the substrate using ultrasonic wave vibration to improve the diamond nuclei-forming density during diamond coating. *See column 9, lines 8-22.*

In contrast, the claimed article comprises an etched surface where the binder is removed from around the hard constituent particles forming voids that extend into the composite portion. Omori discloses etching to remove any binder that oozes onto the surface of the substrate and in some cases, the binder in the surface modified layer can also be etched. See, column 8, line 5 to column 9, line 7. However, this does not include removal of the binder phase from around the hard constituent particles to form voids to a depth of between 3 microns and about 15 microns as clearly stated in Omori. While Omori discloses scratching of the substrate surface, the scratching is not limited to the binder phase and would also scratch the surfaces of the hard constituent particles. In addition the scratching is not intended to create voids so that the coating material can be disposed in the voids. The disclosure of Omori does not contain each and every element set forth in the claims 50-58.

U. S. Patent No. 5,623,766 issued to Moriguchi et al.

Moriguchi discloses a coated cemented carbide comprising coarse and fine tungsten carbide particles, a cobalt binder and a coating layer comprised of a layer of carbides, nitrides, carbonitrides, oxynitrides, or boronitrides of titanium, zirconium and/or hafnium and at least one layer of aluminum oxide and oxides of titanium, zirconium and/or hafnium. *See column 3, lines 37-55.* The fine particles of tungsten carbide are disposed in the spaces among the coarse tungsten carbide particles. *See column 8, lines 29-32.* To determine the ratio of fine particles to coarse particles, an arbitrary cross section of the cemented carbide is mirror-polished and etched. The ratio is then determined by observation of the precipitated eta phase and free carbon in the resultant texture. *See column 7, lines 32-38 and column 11, lines 34-47.* A coating layer with a thickness of 0.2 to 100 μm is deposited on the surface of the cemented carbide. *See column 13, lines 3-5 and lines 39-41.*

In the coated cement carbide disclosed by Moriguchi, etching the cemented carbide as an analytical method to determine the ratio of fine to coarse hard particles. The etched surface is an arbitrary cross section of the cemented carbide and not the surface layer. In addition, the etching process is designed, in part, to form the eta phase, which can then be viewed by optical means. In contrast, the article claimed in the subject application etches the surface of the composite material to enhance adhesion of the wear-resistant coating. The etching process is designed to avoid the formation of eta phase, since the presence of eta phase degrades the properties of the composite material. The cement carbide disclosed by Moriguchi does not include each and every element as set forth in the claims of the subject application.

U. S. Patent No. 5,494,635 issued to Bennett

Bennett discloses a process to carburize cemented carbide substrates to form substrates that have stratified zones enriched in cobalt binder wherein the cobalt content decreases as one moves away from the surface toward the interior of the substrate. *See column 3, lines 65-67, and column 4, lines 1-9.* After sintering, the stratified substrate has a thin graphite layer and a thin cobalt layer above the stratified enriched zone. *See column 5, lines 15-17.* "Prior to coating, the thin cobalt layers that form above the enriched zones on the as-sintered parts are removed down to the [tungsten carbide] grains at the top of the zone, but the cobalt between these grains is not removed." *See column 5, line 66 to column 6, line 2, see also claim 28, column 23, line 40 to column 24, line 3.* Therefore, voids are not created. Hard coatings are then deposited on the surface of the binder enriched substrate. *See column 6, lines 4-10.*

The Bennett process creates a substrate that is stratified in cobalt content. This process creates a thin layer of cobalt on the surface of the substrate that is removed down to the top of the hard particles, "but no further" (*see examples 21 and 22, column 19, line 14 and column 20 line 21*). The removal process is designed not to remove the cobalt from between the grains of hard particles. In the subject application, the claimed article surface is etched and the binder phase is removed to a depth of about 3 µm to about 15 µm into the composite portion. The etching creates voids between the hard constituent particles. The Bennett process does not disclose removal of the binder to create voids between the hard particles and therefore does not disclose each and every element of the claimed article.

U. S. Patent No. 5,484,468 issued to Östlund et al.

The Östlund reference discloses a coated cemented carbide insert and method for making the coated insert. The method includes formation of the gradient-cemented carbide that has a binder enriched surface zone that is essentially free of cubic phase (i.e. carbides and/or carbonitrides of titanium). *See column 2, lines 7-9 and column 3, lines 41-42.* The binder enriched surface zone contains mainly tungsten carbide and binder phase. *See column 3, line 45.* Rounding of the edge of the insert removes the binder phase enriched zone such that "the cubic phase extends to the rounded surface." *See column 3, lines 46-48.* After edge rounding, the cemented carbide inserts may be coated with a thin wear resistant coating. *See column 4, lines 1-6.*

The Östlund process makes cemented carbide inserts with a surface zone enriched in binder phase and free of cubic phase. The edge of the Östlund insert is rounded rather than etched. The rounding process removes the binder phase enriched zone, which comprises mainly tungsten carbide and binder. In the subject application, the etching process is patentably different from the rounding process. The etching process of the subject application removes only binder phase leaving the hard constituent particles substantially intact. Even if one considers rounding and etching to be synonymous, the rounding process of Östlund does not leave the hard constituent particles substantially intact nor does it create voids as claimed.

In addition, the Östlund insert requires the binder phase to have a greater concentration at the surface zone compared with the body of the insert. The surface zone of the invention of the subject application is not enriched in binder phase. The etching process selectively removes the binder from between the hard particles to a depth of between 3 µm and about 15 µm. The Östlund reference does

not disclose each and every element as set forth in the claims of the subject application.

U. S. Patent No. 5,478,634 issued to Setoyama et al.

The Setoyama reference discloses an ultra-thin laminate coating film that improves wear resistance of a cutting tool. *See column 2, lines 20-24.* The ultra-thin laminate may be coated on a hard substrate such as a tungsten carbide based cemented carbide where the laminate has a thickness of 0.5-10 μm. *See column 5, lines 40-43.* The individual laminate layers have a thickness of 0.2-20 nm. *See claim 1, column 24, lines 60-61.* As a method to improve adhesion between the laminate and the surface of the cemented carbide substrate, an intermediate layer of metal carbides, nitrides and/or oxides with a thickness of 0.05-5 μm may be interposed between the laminate and the surface. *See column 3, lines 20-28.* Setoyama discloses a comparison specimen comprising a cutting insert with a coating of a first layer of titanium nitride, a second layer of titanium carbonitride and a third layer of titanium nitride having thickness of 1 μm, 2 μm and 1 μm respectively. *See column 9, lines 58-63 and Table 5, specimen 5-1 or column 10, lines 24-26 and Table 7, specimen 7-1.*

Setoyama does not disclose an etched surface region comprising voids between the substantially intact hard constituent particles with the wear resistant coating disposed in the voids. Instead, Setoyama uses an intermediate layer to increase adhesion between the laminate and the tool surface. In addition, the individual laminate layers of Setoyama are significantly thinner (0.2-20 nm) the depths of the voids of the claims of the subject application.

While Setoyama does disclose a laminate composition similar to that claimed in claim 59 of the subject application, the laminated tool is used only for comparison purposes to the ultra-thin laminated tool. This comparison laminate tool

does not possess an etched surface region comprising substantially intact hard constituent particles and voids between the substantially intact hard constituent particles. In addition, the comparison tool does not disclose the laminate coating disposed in voids on the surface of the laminated tool. Thus the Setoyama reference does not set forth each and every element as claimed in the subject invention.

U. S. Patent No. 5,451,469 issued to Gustafson et al.

Gustafson discloses a cemented carbide body containing tungsten carbide and cubic phases in a binder phase wherein the binder phase is stratified. The body has a surface zone that is enriched in binder phase and essentially free of cubic phase. *See column 2, lines 38-42.* During formation of the stratified carbide body, a thin layer of cobalt and/or graphite forms on top of the cemented carbide surface. *See column 3, lines 45-47.* The cemented carbide inserts can be coated with known thin wear-resistant coatings, preferably with an innermost coating of a carbide, nitride, carbonitride, oxycarbide, oxynitride or oxycarbonitride of titanium and a top coating of aluminum oxide. *See column 4, lines 35-41.* Prior to coating, the cobalt and/or graphite layer on top of the cemented carbide surface is removed by etching or blasting. *See column 4, lines 42-44.*

The Gustafson process makes a stratified cemented carbide insert with a surface zone enriched in binder phase and free of cubic phase. The process results in a thin layer of cobalt and/or graphite <u>on top of</u> the surface of the insert. This thin layer is removed by etching. Gustafson does not disclose etching the binder phase below the surface of the article surface. In contrast, the subject application claims an article comprising an etched surface region comprising voids between substantially intact hard constituent particles, wherein the voids extend to a depth of between 3 μm and about 15 μm.

The Gustafson insert is stratified requiring the binder phase to have a greater concentration at the surface zone compared with the body of the insert. The surface zone of the invention of the subject application is not enriched in binder phase. At best, the binder phase concentration at the surface zone is equal to or slightly less than that of the remainder of the article, due to the voids in between the hard particles to a depth of between 3 μm and about 15 μm. Gustafson does not disclose each and every element set forth in the claims of the subject application.

In addition, the Gustafson disclosure does not disclose a three-layer wear-resistant coating consisting of two titanium nitride layers with a titanium carbonitride layer therebetween. Gustafson only discloses a two-layer coating of an innermost titanium containing layer and an outermost oxide layer. As such Gustafson does not disclose each and every element of claims 59-65 of the subject application.

U. S. Patent No. 5,374,471 issued to Yoshimura et al.

In the '471 patent Yosimura discloses a cemented carbide insert comprising tungsten carbide; carbides, nitrides and carbonitrides of titanium, tantalum and niobium; and a cobalt binder. The surface layer of the insert has a thickness of 5-10 μm and is enriched in cobalt binder content and depleted in cubic phase compared to the contents of the core. *See column 5, lines 39-47.* The surface layer is also substantially free of carbon whereas free carbon particles are present in the core. *See column 5, lines 53-58.* The insert is coated with a wear resistant layer that may comprise 2 layers of titanium nitride with a layer of titanium carbonitride disposed between along with other layers of material. *See column 8, lines 48-51.* Prior to coating, the surface of the insert may be treated to barrel finishing, shot blasting and/or acid dripping. *See column 6, lines 26-29.* To increase chipping resistance, the surfaces of the coated alloy are shot peened. *See column 6, lines 38-50.*

The '471 patent does not disclose an etched surface region comprising voids. The specification of the '471 patent states that an objective of the invention is to create a cutting tool "in which the surface layer of the substrate material is free of pores." *See column 5, line 30-31.* The specification also states that the procedure produces a substrate material with "less tendency to form detrimental microstructural phases, such as pores and the brittle phases (eta phase)" to improve bonding with the coatings. *See column 14, lines 6-9.* The specification of the Yoshimura '471 patent makes it clear that voids or pores on the surface layer of the insert are undesirable since, according to the '471 patent, it hinders bonding of the coating to the surface layer. In contrast, the subject application discloses an etched surface region comprising voids between the substantially intact hard constituent particles. The coating is disposed in the voids. In the present application, bonding between the surface of the substrate and the coatings in enhanced by the presence of the voids whereas in the '471 patent the bonding is enhanced by the absence of voids in the surface layer.

In addition, the Yoshimura '471 patent has a surface layer that is enriched in cobalt binder phase. The surface zone of the invention of the subject application is not enriched in binder phase. As such, the Yoshimura '471 patent does not disclose each and every element of the claims of the present application.

U.S. Patent No. 5,372,873 issued to Yoshimura et al.

In the '873 patent Yosimura discloses a cemented carbide cutting tool comprising tungsten carbide; carbides, nitrides and carbonitrides of titanium, tantalum and niobium; and a cobalt binder. The surface layer of the insert has a thickness of up to 50 μm and is enriched in cobalt binder content and substantially free of cubic phase compared to the contents of the core. *See column 5, lines 26-30.*

The surface layer is also substantially free of carbon whereas free carbon particles are present in the core. *See column 5, lines 53-58.* The tool is coated with a wear resistant layer that may comprise 2 layers of titanium nitride with a layer of titanium carbonitride disposed between along with other layers of material. *See column 8, lines 4-7.* The surface layer is honed to a depth of 0.07 mm on the rake surface and 0.04 mm on the flank surface prior to coating. *See column 9, lines 24-27.* To increase chipping resistance, the surfaces of the coated alloy are shot peened. *See column 8, lines 66-67.*

The '873 patent does not disclose an etched surface region comprising voids. The specification of the '873 patent states that an objective of the invention is to create a cutting tool "in which the surface layer of the substrate material is free of pores." *See column 5, line 16-20.* The specification also states that the procedure produces a substrate material with "less tendency to form detrimental microstructural phases, such as pores and the brittle phases (eta phase)" to improve bonding with the coatings. *See column 13, lines 12-16.* The specification of the Yoshimura '873 patent makes it clear that voids or pores on the surface layer of the insert are undesirable since it hinders bonding of the coating to the surface layer. In contrast, the subject application discloses a substrate surface wherein the cobalt binder is etched from between the hard constituent particles creating voids. The coating is then disposed in the voids on the surface layer. In the present application, bonding between the surface of the substrate and the coatings in enhanced by the presence of the voids whereas in the '873 patent the bonding is enhanced by the absence of voids in the surface layer.

In addition, the Yoshimura '873 patent has a high concentration of cobalt binder phase in the surface layer. The surface region of the invention of the

subject application is not enriched in binder phase. Also, Yoshimura hones the surface layer to a depth of at least 0.04 mm prior to coating. This honing is unlikely to leave the hard constituent particles substantially intact as is demonstrated in the subject application. As such, the Yoshimura '873 patent does not disclose each and every element of the claims of the present application.

U.S. Patent No. 4,399,168 issued to Kullander et al.

Kullander discloses a process for the production of coated cemented carbide products. The process involves coating the surface of carbide with a wear resistant coat, heating the product to near the melting point of the cobalt binder to diffuse the tungsten and cobalt into the coating, oxidizing the coating and applying a second coating of an oxide layer. *See column 2, lines 1-10.* The patent discloses etching the surface of the coated carbide after the heating step to remove cobalt binder or tungsten that has penetrated the outer layer. *See column 4, lines 50-54.* The etching process can also remove the tungsten and/or tungsten carbide. *See column 4, lines 58-59.*

In the present application, the etching process occurs prior to the coating process. The wear-resistant coating is disposed in the voids. In contrast, Kullander etches the substrate surface after the application of the first coating and heating to diffuse the cobalt binder and tungsten. In Kullander, the etching removes cobalt that has diffused to the surface of the wear-resistant coating. In addition, the Kullander etching can remove some of the tungsten and/or tungsten carbide particles whereas in the present application the hard constituent particles remain substantially intact. The Kullander patent does not disclose each and every element of the claims of the present application.

CONCLUSION

For the reasons discussed above, none of the cited references describe each and every element of the article of claims 50, 52-58, and 60-65. Accordingly, withdrawal of the rejection under 35 U.S.C. § 102 for each reference and reconsideration of these claims, and consideration of the new claims, is respectfully requested. Furthermore, it is asserted that based on the clear distinctions between the claims of the subject application and the references set forth above, no reference or combination of references cited by the Examiner suggests the claimed article. Accordingly, it is respectfully submitted that the claims or the subject application cannot be said to be rendered obvious by the teachings of the cited references in any combination. In view of the foregoing amendments, Applicants respectfully submit that the subject application is in condition for allowance.

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